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INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference FP1905	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/SG 03/00137	International filing date *(day/month/year)* 03.06.2003	Priority date *(day/month/year)* 03.06.2003
International Patent Classification (IPC) or both national classification and IPC H03K4/501		
Applicant INFINEON TECHNOLOGIES AG et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
09.11.2004	20.09.2005
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Robinson, V Telephone No. +49 89 2399-7572

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/SG 03/00137

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-13 as originally filed

Claims, Numbers

1-10 filed with telefax on 08.09.2005

Drawings, Sheets

1/10-10/10 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

   see separate sheet

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	
	No:	Claims	1-3,6-10 (NO), 4-5(YES)
Inventive step (IS)	Yes:	Claims	
	No:	Claims	4,5(NO)
Industrial applicability (IA)	Yes:	Claims	
	No:	Claims	1-10(YES)

2. Citations and explanations

   see separate sheet

Re Item I

This report has been established as if the amendments had not been made. The amendments merely inserted the word "directly" into the fourth line of claim 1 and the 6th line of claim 10. The meaning of the word "directly" is however, in this context, extremely vague. The examiner is unable to ascertain the intended meaning of the word, as it could be:

- an indication of the time delay between the increasing control output and the increasing frequency, i.e. immediately; or
- an indication that there is no intermediate process or function between the control output and the frequency; or
- an indication of the mathematical relationship between the control output and the frequency, i.e. the opposite of "inversely";

The claim as amended must therefore be interpreted in the light of the description. The description and figures however do not help clarify the intended meaning as the word "directly" does not appear therein, nor does any statement which clearly relates to a possible meaning of "directly". Particularly, the passage on page 10, lines 23-30 in combination with figure 7 does not provide a meaning or basis to the word. Figure 7 depicts a graph of frequency against an undisclosed value, which the examiner suspects could possibly be an input control current. The corresponding description however does not specify what the value is. The description furthermore contradicts this interpretation by referring to the graph as an oscillator gain characteristic, which would depict the oscillator gain for a range of output frequencies and not the output frequencies for a range of input control values.

Concerning claim 10, the word "directly" is used in a different context, namely "comparing the signal directly to a reference signal". At least the first two of the above possible meanings could also apply to this context, and similarly, no basis to support either meaning of the word could be found in the description.

Since the limitation of scope implied by the amendments could not be clearly identified, and no basis could be found in the original application documents for the amendments in any interpretation, those amendments are not in accordance with Rule 70.2 PCT. This report has been established as if the amendments had not been made, hence the examined claims relate effectively to the originally filed claims.

Re Item V

Reference is made to the following documents:
D1: US-A-5 497 127 (SAUER DONALD J)
D2: DE 43 40 924 A (TELEFUNKEN MICROELECTRON)

1. The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of independent claims 1 and 10 and dependent claims 2,3 and 6-9 is not new in the sense of Article 33(2) PCT.

1.1 The document D1 discloses (the references in parentheses applying to this document):

A tunable oscillator (see figure 1) comprising a control supply (CVC0, 122,124,126, 128, 130, 134, 136) outputting a control output (charging current of 152) for tuning the tunable oscillator and an oscillator circuit (144, 146, 148, 150, 152) outputting (CI) a frequency which increases with increasing control output (see column 5, line 63- column 6, line 6). The tunable oscillator of D1 further comprises a control circuit (comparator 175, amplifier 183 and inverter 192) controlling the frequency of the oscillator circuit in response to a comparison (by comparator 175) of an oscillator circuit signal (CI) with a reference signal (NI). D1 also discloses a propagation delay compensation circuit (185, 187, 189, 191, 195, 197, 198) for varying the amplitude of the reference signal (NI) at substantially the same frequency as the oscillator (see the curves of NI and CI in figures 2 and 3 - NI varies at the same frequency as the oscillator signal CI) to compensate for propagation delay of signals from the control circuit to the oscillator circuit (see column 4, line 38- column 5, line 10 and column 6, lines 1-6).

It is noted that the oscillator circuit in D1 indeed outputs a frequency (at CI) which increases with increasing control output (the charging current of 152). While it is acknowledged that the hysteresis applied to the comparator also has an effect on the output frequency, this does not diminish the fact that the increased charging current charges the capacitor more quickly, thereby necessarily increasing the frequency. In fact this is much the same as the current application, where the frequency of the oscillator is dependent not only on the input control current, but also on the control output and the variable reference voltage applied to the comparators.

Consequently, D1 discloses all features of independent claim 1.

1.2 D1 also discloses all features of independent claim 10. In addition to features which have already been discussed above, including the "comparison (by comparator 175) of an

oscillator circuit signal (CI) with a reference signal (NI)" which is considered equivalent to the "comparing" step of claim 10, D1 further discloses that the control signal (presumably that produced by the control circuit in claim 1, ON in D1), is supplied to both the oscillator (to transistor 148) and the reference circuit (to transistor 198). It can further be seen in D1, figures 2 and 3, that the reference signal (NI) has substantially the same phase as the signal of the oscillator circuit (CI), and that the reference signal (NI) decreases in amplitude as the [frequency of] the oscillator signal increases (compare particularly figures 2 and 3 - figure 3 shown a higher oscillation frequency and a markedly lower reference signal amplitude).

Hence, all features of independent claims 10 are known from D1.

1.3 D1 further discloses all features of the dependent claims 2, 3, and 6-9. These claims are therefore also not novel. See in particular:
- control current through transistor 136 (claim 2);
- capacitor 152, comparator 175 (claim 3);
- first and second reference voltages CS1 and CVCO (claim 6);
- reference signal oscillating with oscillator signal in figures 2 and 3 (claim 7);
- reference signal amplitude changes in inverse to oscillation frequency and to control current, compare figures 2 and 3 (claims 8 and 9);

2. The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 4 and 5 does not involve an inventive step in the sense of Article 33(3) PCT.

2.1 The document D1 is regarded as being the closest prior art to the subject-matter of claim 4, and discloses the features of dependent claim 1, on which claim 4 depends.

The subject-matter of claim 4 therefore differs from this known oscillator in that it comprises two capacitors alternatively charged and discharged in response to a comparison of the voltages of the capacitors with the reference signal.

The problem to be solved by the present invention may therefore be regarded as obtaining a 50% duty cycle. The solution proposed in claim 4 of the present application cannot be considered as involving an inventive step (Article 33(3) PCT) because the application of two capacitors which are charged and discharged in a complementary manner is very common in the field of RC oscillators and is extremely well known to the skilled person.

In order to obtain a 50% duty cycle, the skilled person would therefore consider such a standard oscillator circuit as that disclosed in D2, figure 3, and adapt the circuit of D1, figure 1, by replicating the capacitor, comparator and charging/discharging circuitry. In doing so, the skilled person would arrive at the subject-matter of claim 4, without requiring an inventive step.

2.2 In doing so, the skilled person would likewise arrive at the subject-matter of claim 5, since the standard complementary circuit also requires two comparators.

Claims

I claim:

1. A tunable oscillator comprising:

a control supply outputting a control output for tuning the tunable oscillator;

an oscillator circuit outputting a frequency which increases directly with increasing control output;

a control circuit controlling the frequency of the oscillator circuit in response to a comparison of an oscillator circuit signal with a reference signal; and

a propagation delay compensation circuit for varying the amplitude of the reference signal at substantially the same frequency as the oscillator to compensate for propagation delay of signals from the control circuit to the oscillator circuit.

2. The tunable oscillator of Claim 1, wherein the control supply is a current controlled oscillator and the control output is a control current.

3. The tunable oscillator of Claim 1, wherein the oscillator circuit comprises at least one capacitor charged and discharged in response to a comparison of a voltage of the capacitor with the reference signal.

4. The tunable oscillator of Claim 1, wherein the oscillator circuit comprises two capacitors alternatively charged and discharged in response to a comparison of the voltages of the capacitors with the reference signal.

5. The tunable oscillator of Claim 4, wherein the control circuit comprises two comparators for alternatively charging and discharging the two capacitors in response to comparisons of the voltages of the capacitors with the reference signal.

6. The tunable oscillator of Claim 1, further comprising first and second reference voltages controlling the amplitude of reference voltage output by the propagation delay compensation circuit.

7. The tunable oscillator of Claim 1, wherein the propagation delay compensation circuit oscillates to vary the amplitude of the reference signal to produce a signal rising and falling in phase with the output of the oscillator circuit.

8. The tunable oscillator of Claim 1, wherein the propagation delay compensation circuit decreases the amplitude of the reference signal as the control output increases and increases the amplitude of the reference signal as the control output decreases.

9. The tunable oscillator of Claim 2, wherein the amplitude of the reference signal decreases as the control current increases over a range of values and the amplitude of the reference signal increases as the control current decreases over the range of values so that a capacitor of the oscillator circuit charges to substantially the same voltage peak over the range of values.

10. A method for compensating the propagation delay in a tunable oscillator comprising the steps of:

inputting a control current to an oscillator circuit for tuning the tunable oscillator;

detecting a signal of the oscillator circuit and comparing the signal directly to a reference signal from a reference circuit to produce a control signal;

supplying the control signal to both the oscillator and the reference circuit; and

outputting from the reference circuit the reference signal, the reference signal having substantially the same phase as the signal of the oscillator circuit and decreasing in amplitude as signal of the oscillator circuit increases.